# STA advice notes

## Design life of timber frame buildings

STRUCTURAL TIMBER ASSOCIATION
*Building solutions in timber*

No. 2 - March 2013

# Scope of this document

This advice note from the STA provides generic information on the design life of timber frame structures as presented in various codes. It also covers the durability and performance of timber frame in relation to design life. Its content will be of use to architects, building engineers, developers, project managers, property managers and self builders and anyone planning a timber frame project, whether large or small.

# A brief history of Timber Frame

Timber frame building methods have been used extensively throughout the world for centuries.

The most common method of timber frame construction used today, referred to as 'platform timber frame', comprises walls of closely centred studs with top and bottom rails, together with wood-based sheathing boards provided for whole building rigidity, is also a well proven and established form of construction for many types of buildings. There are examples of platform frame construction in the UK dating back to the 1700's but it was in the 1960's that this method of building became commonplace.

The platform frame building method generally adopts factory-built frames which are assembled on site in large sections, thereby minimising the amount of connections which need to be made on site. When a timber 'kit' is obtained from a STA member company, this factory-based approach delivers products that are compliant with STA Quality Approval processes.

Over 70% of the population of the developed world lives in timber frame housing. This includes significant numbers in North America, Scandinavia, Australia, New Zealand and Japan. In Canada and the US over 90% of low-rise buildings use timber frame methods. On account of the material's inherent sustainability credentials and the ability of timber frame buildings to provide reduced heat loss characteristics, timber frame is commonly used as a preferred building method for houses, schools, sports halls, hotels, offices, health care facilities and flats.

STRUCTURAL
TIMBER ASSOCIATION
*Building solutions in timber*

# Performance of structures

There are many examples of different types of construction, using all types of materials, that can suffer from poor performance and durability issues. Concrete spalling, steel corrosion, timber rotting, damp penetration through blockwork, masonry cracking, overly-flexible steel frames, sulphate attack on mortar, inadequate acoustic performance of party wall constructions and inadequate fire protection, the list is endless.

In the majority of cases however, the cause of this poor performance is poor quality construction. Often reports of poor performance relate to a one off problem, errors in the build quality and perhaps design philosophy which would have led to defects regardless of the material used.

Timber frame has a demonstrable history of successful durability and longevity. There are volumes of projects that adopts timber frame which have provided, and continue to provide, good performance.

Research into the performance of timber frame construction has predominantly been carried out by the Building Research Establishment (BRE) who have provided an independent view of the construction method. The BRE undertook extensive research into the durability of timber frame (BRE - Timber- framed housing - a technical appraisal - Freeman et al - 1983). This report concluded that properly constructed timber frame buildings did not have durability issues but that the construction method required controlled design and build processes and that, as for all materials, good workmanship was pivotal in ensuring that the method delivered predicted performance. It is, in part, for this reason that the STA insists that its members implement Quality Assurance systems.

Following on from the 1983 report and following the findings of site surveys and other practical experience of timber-framed housing, the BRE published additional guidance in the form of BRE reports: BR 283&284 - Timber frame housing systems built in the UK 1920-1975', which formed a part of a wider set of investigations covering a comprehensive study of all types of housing carried out for the Department of the Environment. BRE found that the incidence of timber decay in the dwellings they inspected was generally very low and, with a few exceptions, any decay was localised, superficial, and usually the result of poor workmanship or inadequate maintenance.

STRUCTURAL TIMBER ASSOCIATION
*Building solutions in timber*

BRE has concluded that the performance of timber frame dwellings built between 1920 and 1975 is generally similar to that of traditionally built dwellings of the same age. Provided regular maintenance is carried out, and that any repair work meets accepted levels of good workmanship, then timber framed dwellings should exhibit a performance comparable with masonry dwellings of the same age into the foreseeable future.

It is recognised by NHBC and other third party certification organisations that correctly built timber frame structures are capable of delivering the same design life as other methods of build. The NHBC require a quality certificate to be completed by the timber frame designer which records the minimum compliance of the timber frame structure to the NHBC guidelines.

# Design life of structures

| **In the UK the British Standards have a design life for buildings as noted in the table below:** | | |
|---|---|---|
| **Design life to BS 7543: 1992** | Structures | Construction<br>Design life description: Medium Life<br>Design life: minimum period 30 years |
| | | Refurbishment<br>Design life description: Short Life<br>Design life: minimum period 10 years |
| | Components & assemblies | Main structural elements: design life: 60 years<br>Floor finishes: design life < 60 years<br>External cladding: maintainable / design life: 60 years with maintenance |
| **Design life to BS EN 1990: 2002** | | Design working life = 50 years<br><br>The euro code also directs that the structure shall be designed such that deterioration over its design working life does not impair the performance of the structure below that intended, having due regard to its environment and the anticipated level of maintenance |
| **Design life to BS ISO 15686-1: 2000** | Components & assemblies within a building | Inaccessible or structural components: 60 years<br>Expensive or difficult to replace components: 60 years<br>Major replaceable components: 40 years<br>Building services: 25 years Easy to replace components: 3-6 years |
| **Specific to timber frame the following codes provide design requirements:** | | |
| **Design life to BS5268: Part 5: 1989** | Timber in buildings | Desired service life = 60 years |

STRUCTURAL TIMBER ASSOCIATION
*Building solutions in timber*

Anybody considering the use of timber frame construction methods for building structures would be advised to ensure that they engage competent designers and Quality Assured timber frame manufacturing companies. Timber frame designers should be familiar with 'Timber frame construction - 5th Edition' published by TRADA.

Design guides and links to further information and best practice for timber frame construction is available from the following sources:

**www.structuraltimber.co.uk**

**www.trada.com**

**www.bre.co.uk**

In determining the durability and maintenance of buildings the following should be considered:

**The difference between durability and performance**

'Durability' is defined in the British Standard as the ability of a building and its parts to perform its required function over a period of time. 'Performance' is the building's behaviour related to its intended use.

The quality of the exposed timber components and workmanship in a building should be appropriate for the required service life of the building and the conditions in which it will be used. For example timber cladding may be high quality requiring low maintenance periods or lower quality requiring regular maintenance. Similarly, cladding fixed to an exposed building face may require more regular maintenance than cladding fixed to a sheltered elevation.

The designated 'Design Life' for new buildings is typically taken as a minimum period of 60 years and the design life for components or assemblies within the building will fall into the following categories:

- Replaceable - shorter life than the building life where a requirement for replacement during the life of the building is envisaged at design stage, e.g. flat roof coverings.
- Maintainable - will last, with periodic treatment, for the life of the building, e.g. cladding systems.
- Lifelong - will last for the life of the building. eg structure and wall frames

STRUCTURAL TIMBER ASSOCIATION
*Building solutions in timber*

**The selection of materials and components**

Materials and components should be selected based on the required service life during which no excessive expenditure is required on operation, maintenance or repair of the component or construction. For housing this will be approximately 30 years. For hotels and schools this may be 10 to 20 years or more if declared at the design stage.

**Ease and cost of maintenance**

The ease and cost of maintenance of a building should be an integral part of the design process in which due consideration is given to the lifelong effects of material/component selections, construction detailing and overall building design. In establishing the principles with regard to the selection of materials and components for durability/performance it is possible to more accurately assess the level of maintenance which will be required over the service life of a building.

**Informed decisions**

Consideration at design stage on the intended service life and maintenance requirements of components and materials will permit a more systematic approach to maintenance. BS 8210: 1986 identifies the following levels of maintenance:

- Repair only - maintenance restricted to restoring items to their original function after a failure, e.g. replacement of jammed valves and re-glazing of broken windows.
- Scheduled maintenance plus repair - maintenance work carried out to a pre-determined interval of time, e.g. five-yearly external joinery painting cycle.
- Condition based maintenance plus repair - maintenance carried out as a result of knowledge of an item's condition, e.g. reported through systematic inspection procedure.

**Quality of workmanship on site and site inspection**

The objective of site inspections is to check that the Contractor is properly executing the works and meeting the construction and quality specified. Monitoring the quality of workmanship on site is an essential part of the construction process as deficiencies in the completed building can negate many aspects of the design process. Routine site inspections should be carried out by the employer's agent, supervising officer or appointed consultants on a regular basis. A Clerk of Works should conduct more frequent inspections or be resident on site, depending on the size of the scheme.

Structural Timber Association
The e-Centre
Cooperage Way
Alloa
FK10 3LP

t: 01259 272140
f: 01259 272141
e: office@structuraltimber.co.uk
w: www.structuraltimber.co.uk

STRUCTURAL TIMBER ASSOCIATION
*Building solutions in timber*